# What Parents Should Know

## about Medical Radiation Safety

Arkansas Foundation for Medical Care℠
afmc.org

ARKANSAS DEPARTMENT OF HUMAN SERVICES

image gently℠

www.imagegently.org

Imaging helps guide physicians in the diagnosis and management of their patients. Some types of imaging use ionizing radiation. The following information is to help parents and caregivers understand some of the issues and questions surrounding this topic.

## What is medical radiation?

There are several different ways radiation can be used to help children medically. Radiation can be used for imaging or for therapy. Diagnostic imaging techniques using radiation include X-rays, computed tomography (CT) scans, and radionuclide (nuclear medicine) studies. Therapeutic techniques include radiation for the treatment of cancer or an overactive thyroid gland.

## What is an X-ray?

X-rays are invisible beams of ionizing radiation that pass through the body and are altered by different tissues to create images. This results in a 2-dimensional picture that shows bones, lungs, and many organs. These exams are not painful but require your child to stay still for the picture. In some cases, parents may be invited to be present in the room while the images are taken to help keep the child comfortable. Depending on the region to be X-rayed, lead shields may be used on your child to decrease radiation exposure to areas not being imaged.

## What is a CT scan?

CT or CAT scans use x-rays generated from a source that is rotated around the body to create 3-dimensional pictures of the body. These produce many "slices" that the computer reconstructs into images. These pictures give more information about the inside of the body than a single X-ray image. CT studies can provide critical information for the care of your child, but obtaining the images results in more radiation exposure for the study than a single X-ray.

CT scanners look like a large donut. Your child will need to lie still on a table while the table moves through this "donut." The study is relatively quick and painless, with nothing touching your child. However, at times children may be afraid of the large machine. Parents are encouraged to be with their child during the study to reassure them. At times sedation is given to younger children to help them to stay still while the study is being performed.

Intravenous (IV) contrast may be given to help see organs and blood vessels and requires a needlestick. These contrast medicines are usually safe. Children with severe kidney problems may not be able to get IV contrast as the contrast gets removed from the body through the kidneys. Allergic reactions from the contrast may occur rarely in children. Before IV contrast is given, you will be asked if your child has unusual allergies or kidney problems. It is important for you to discuss these issues with your doctor prior to the study being performed.

## What are nuclear medicine studies?

Nuclear medicine studies use small amounts of radioactive drugs that concentrate in different organs or tissues and emit rays called gamma rays. The gamma rays are detected by a camera which then converts the rays to electronic signals that build a picture. The amount of radiation exposure depends on the type of study being performed. An IV line is usually required to administer the drug. The studies are not painful, but your child needs to lie still on a table while images are being obtained. You are encouraged to be at your child's side during the exam. At times, sedation may be needed for younger children so they don't move while the pictures are being collected.

## How much radiation is used in these exams?

We all are exposed to small amounts of radiation daily from soil, rocks, building materials, air, water, and cosmic radiation. This is called naturally occurring background radiation. The amount we are exposed to depends on where we live. For example, people living in the high mountains of Colorado are exposed to more cosmic radiation than people who live at sea level. Radiation can be measured in many ways. Measurements can be used to estimate the radiation dose deposited in the whole body or to an individual organ. Because every patient is different in size and shape, different X-ray settings must be used to accommodate for these differences. Estimating doses for even the same type of study can be misleading and comparing estimated doses for different exams is confusing. One way of looking at doses from X-ray examinations is to compare effective radiation dose estimates from different sources using millisievert units (mSv).

| Source | Estimated effective dose (mSv) |
|---|---|
| Natural background radiation | 3 mSv/yr |
| Airline passenger (cross country) | 0.04 mSv |
| Chest X-ray (single view) | up to 0.01 mSv |
| Chest X-ray (2 view) | up to .1 mSv |
| Head CT | up to 2 mSv |
| Chest CT | up to 3 mSv |
| Abdominal CT | up to 5 mSv |

The radiation used in X-rays and CT scans has been compared to background radiation we are exposed to daily. This also is misleading as this refers to whole body dose which is not truly comparable to studies that image only a portion of the body. However, this comparison may be helpful in understanding relative radiation doses to the patient.

| Radiation source | Days background radiation |
|---|---|
| Background | 1 day |
| Chest X-ray (single) | 1 day |
| Head CT | up to 8 months |
| Abdominal CT | up to 20 months |

## What are the risks from medical radiation?

There is no conclusive evidence that radiation from diagnostic X-rays causes cancer. However, some studies of large populations exposed to radiation have demonstrated slight increases in cancer risk even at low levels of radiation exposure, particularly in children. Major national and international organizations responsible for evaluating radiation risks agree there likely is no low-dose radiation "threshold" for inducing cancers. To be safe, we should act as if low doses of radiation may cause harm.

The risk for radiation induced cancers should be evaluated against the statistical risk of developing cancer in the entire population. The overall risk of a cancer death over a person's lifetime is estimated to be 20-25%. For every 1,000 children, 200-250 will eventually die of cancer if never exposed to medical radiation. The estimated increased risk of cancer over a person's lifetime from a single CT scan is controversial but has been estimated to be a fraction of this risk (0.03- 0.05 %). These estimates for the population as a whole do not represent a direct risk to one child.

Another way of assessing the relative risk of having a CT scan is to compare the theoretical risk of one abdominal CT scan to other risks. The estimated risk of one abdominal CT has been compared to:

- driving 7,500 miles (accident risk)
- motorcycling for 1,000 miles (accident risk)

Despite limitations of estimating radiation dose, this information shows that the risk of developing cancer related to a single CT scan is very small, but the available research indicates that there might be some risk and the risk may be cumulative.

## How can we minimize radiation risk to my child?

There are ways to ensure that your child is exposed to the smallest amount of radiation possible during an imaging study. The Image Gently Campaign is promoting optimal scanning strategies for children and they are listed below:

- Image when there is a clear medical benefit
- Use the lowest amount of radiation for adequate imaging based on size of the child
- Image only the indicated area
- Avoid multiple scans
- Use alternative diagnostic studies (such as ultrasound or MRI) when possible

## If my child's doctor requests a CT scan, should I let it be done?

As with any medical procedure, benefit of the exam should always outweigh any risk. CT scans are a very valuable imaging technique that can improve medical care and diagnose some illnesses that no other tests can. CT scans can help determine the best treatment options, avoid other tests or surgery, and improve health outcomes. It is important to remember that if your child faces a serious illness that requires a CT scan, you should have no reluctance about having the exam. The benefits often clearly outweigh the risks to your child. If CT is the best test, ask if your imaging provider uses appropriate low dose techniques to minimize radiation exposure.

## How can I be sure that my imaging facility is using appropriate reduced radiation techniques?

Some facilities that perform CT scans on adults may not use radiation dose reduction techniques when scanning children. You won't know unless you ask and it is reasonable and within your rights to ask. Your imaging provider should be able to provide you with information about how they reduce radiation doses. You should also ask if the facility is accredited in CT by the American College of Radiology.

## What are the alternatives to CT?

CT scans may be the best way to get the imaging information needed to make clinical decisions about the care for your child.

At times your doctor may decide it is safer to simply observe your child before committing them to a CT scan. Waiting may be difficult for you and your family, but may result in the same outcome without exposing your child to unnecessary radiation.

Ultrasound and magnetic resonance imaging (MRI) are imaging techniques that do not use radiation. Sometimes these imaging methods can provide similar diagnostic information and can be useful alternatives. MRI, a long exam, may require sedation which carries its own risks. CT scans may be the only way to get the information needed to make clinical decisions about the care best for your child. You should ask your doctor and radiologist whether alternative exams are appropriate for your child's situation.

## If the CT was normal, does it mean we made a mistake having the study done?

Often a normal exam provides useful information about your child. A normal exam may allow you to take your child home, or avoid additional tests or unnecessary procedures.

## If I still have concerns regarding radiation exposure to my child, whom should I talk to?

Initial discussions should begin with the physician who is requesting the exam. Medical professionals must balance the risks and benefits of performing the study. Your doctor and the radiologist (who is also a physician) can work together on decisions about which study is best to perform. If your doctor cannot answer your questions, radiology physicians can provide further information.

The information contained in this publication should not be used as a substitute for the medical care and advice of your pediatrician. There may be variations in treatment that your pediatrician may recommend based on individual facts and circumstances.

Image Gently is the educational and awareness campaign created by the Alliance for Radiation Safety in Pediatric Imaging that was formed in July 2007. It is a coalition of health care organizations dedicated to providing safe, high quality pediatric imaging nationwide. The Society for Pediatric Radiology as well as over 33 other societies are members of this coalition representing more than 500,000 health care professionals in radiology, pediatrics, medical physics, and radiation safety.

## References


Amis ES, Jr., Butler PF, Applegate KE, et al. American College of Radiology white paper on radiation dose in medicine. ***Journal of the American College of Radiology*** 2007; 4:272-284.

Arch ME, Frush DP. Pediatric body MDCT: A 5-year follow-up survey of scanning parameters used by pediatric radiologists. ***American Journal of Roentgenology*** 2008:191;611-617

Brenner DJ, Doll R, Goodhead DT, et al. Cancer risks attributable to low doses of ionizing radiation: Assessing what we really know. ***Proceedings of the National Academy of Sciences of the United States of America*** 2003; 100:13761-13766.

Brenner DJ, Elliston CD, Hall EJ, Berdon WE. Estimated risks of radiation-induced fatal cancer from pediatric CT. ***American Journal of Roentgenology*** 2001; 176:289-296.

Brenner DJ, Hall EJ. Current concepts - Computed tomography - An increasing source of radiation exposure. ***New England Journal of Medicine*** 2007; 357:2277-2284.

Brody AS, Frush DP, Huda W, Brent RL, Radiology AAP. Radiation risk to children from computed tomography. ***Pediatrics*** 2007; 120:677-682.

Cardis E, Vrijheid M, Blettner M, et al. The 15-country collaborative study of cancer risk among radiation workers in the nuclear industry: Estimates of radiation-related cancer risks. ***Radiation Research*** 2007; 167:396-416.

Chodick G, Ronckers CM, Shalev V, Ron E. Excess lifetime cancer mortality risk attributable to radiation exposure from computed tomography examinations in children. ***Israel Medical Association Journal*** 2007; 9:584-587.

Frush DP, Applegate K. Computed tomography and radiation: understanding the issues. ***Journal of the American College of Radiology*** 2004; 1:113-119.

Frush DP, Donnelly LF, Rosen NS. Computed tomography and radiation risks: What pediatric health care providers should know. ***Pediatrics*** 2003; 112:951-957.

Goske MJ, Applegate KE, Boylan J, et al. The 'Image Gently' campaign: increasing CT radiation dose awareness through a national education and awareness program. ***Pediatric Radiology*** 2008; 38:265-269.

Huda W, Vance A. Patient radiation doses from adult and pediatric CT. ***American Journal of Roentgenology*** 2007; 188:540-546.

Larson DB, Rader SB, Forman HP, Fenton LZ. Informing parents about CT radiation exposure in children: It's OK to tell them. ***American Journal of Roentgenology*** 2007; 189:271-275.

NAS. Health risks from exposure to low levels of ionizing radiation: BEIR VII phase 2. Washington D.C.: National Academy of Sciences, 2005.

Pierce DA, Preston DL. Radiation-related cancer risks at low doses among atomic bomb survivors. ***Radiation Research*** 2000; 154:178-186.

Preston DL, Ron E, Tokuoka S, et al. Solid cancer incidence in atomic bomb survivors: 1958-1998. ***Radiation Research*** 2007; 168:1-64.

Slovis TL. The ALARA (as low as reasonably achievable) concept in pediatric CT intelligent dose reduction. Multidisciplinary conference organized by the Society of Pediatric Radiology. August 18-19, 2001. ***Pediatric Radiology*** 2002; 32:217-317.


### Helpful web sites

www.imagegently.org

www.cancer.gov/cancertopics/causes radiation-risks-pediatric-CT

www.acr.org

http://hps.org

www.rsna.org

www.radiologyinfo.org

Arkansas Foundation for Medical Care
www.afmc.org

ARKANSAS DEPARTMENT OF HUMAN SERVICES


THIS MATERIAL WAS PREPARED BY THE ARKANSAS FOUNDATION FOR MEDICAL CARE INC. (AFMC) PURSUANT TO A CONTRACT WITH THE ARKANSAS DEPARTMENT OF HUMAN SERVICES, DIVISION OF MEDICAL SERVICES.
THE CONTENTS PRESENTED DO NOT NECESSARILY REFLECT ARKANSAS DHS POLICY. THE ARKANSAS DEPARTMENT OF HUMAN SERVICES IS IN COMPLIANCE WITH TITLES VI AND VII OF THE CIVIL RIGHTS ACT. MB2-CTED.IG.BRO,3/15